ConcepTests

Research has shown that ConcepTest questioning (sometimes called "classroom voting") improves student learning in the STEM (Science, Technology, Engineering and Mathematics) disciplines. The technique promotes classroom discussion and engagement, and it illuminates students' current levels of understanding in formative, non-threatening ways.

Here's how it works. A multiple-choice question is posed to the class. After a minute or so of individual thinking students are asked to vote on the correct answer. This is done in an anonymous way. The high-tech version is with classroom clickers, but low-tech versions where each student has a set of labeled or color coded index cards works almost as well. The instructor can quickly look around (or in the case of clickers get a computer read-out) and tell how many students have the concept down correctly. Then there is a chance for small groups of 2 or 3 to discuss the question and their answers, at which time the voting is repeated. This cycle continues until most students have it right.

The strategy is very versatile. Used to introduce a topic, it can reveal students' current levels of understanding. Used skillfully, it involves students in developing key ideas and can thus replace a good deal of faculty lecture. At the end of a topic, it can check for desired outcomes. Perhaps the biggest challenge is coming up with appropriate questions – ones that get at underlying conceptual understanding.

In mathematics, question development began at calculus level and for courses above. See the Harvard Calculus Consortium materials, and NSF funded projects at Cornell: (http://www.math.cornell.edu/~GoodQuestions/) and Carroll College: (http://mathquest.carroll.edu.) Some publishers now offer collections of such questions with their texts (though the focus is often on procedural knowledge rather than deeper understanding) A 2007 article in MAA's FOCUS Newsletter gives a brief introduction to how one group of faculty uses this technique. (*Teaching with Classroom Voting*, May/June 2007, pages 22,23)

Although resources are more difficult to find at the developmental math and precalculus levels, faculty use at these levels is growing. Those who have spent time constructing their own questions report encouraging results. (A couple of questions to explore understanding of slope can be found on the following page.) Try the following example with a group of friends.

An example

Imagine there is a rope wrapped tightly about the earth at the equator. A 20 meter length of rope is added to it and held in a circular shape with the earth at the center.

Which of the following is the tallest critter that can walk underneath the rope without touching it?

(A) An amoeba.

(B) A kitten.

(C) A human.

Five ConcepTest Questions Relating to Slope

1. A roof has a rise to run ratio of 1 to 5. The slope of the roof is….?

   (a) 5 (b) $\sqrt{24}$ (c) $\frac{1}{5}$ (d) - 20 (e) $\frac{1}{20}$

2. A highway caution sign indicates that a road has a 5% downgrade. The slope of the roadway is….?

   (a) 5 (b) $\sqrt{24}$ (c) $\frac{1}{5}$ (d) - 20 (e) $\frac{1}{20}$

3. A 20 foot ladder is leaning against a house with its bottom 4 feet from the base of the house. The slope of the ladder is….?

   (a) 5 (b) $\sqrt{24}$ (c) $\frac{1}{5}$ (d) - 20 (e) $\frac{1}{20}$

4. A skydiver is falling at a constant rate of 20 feet per second. On a graph, the altitude of the skydiver is plotted against time. The slope of the line graph is….?

   (a) 5 (b) $\sqrt{24}$ (c) $\frac{1}{5}$ (d) - 20 (e) $\frac{1}{20}$

5. Arrange the lines that have the slopes given below, in order of increasing steepness (flattest to steepest).

   (a) 5 (b) $\sqrt{24}$ (c) $\frac{1}{5}$ (d) - 20 (e) $\frac{1}{20}$